# Header Compression for IP-Telephony over Cellular Links

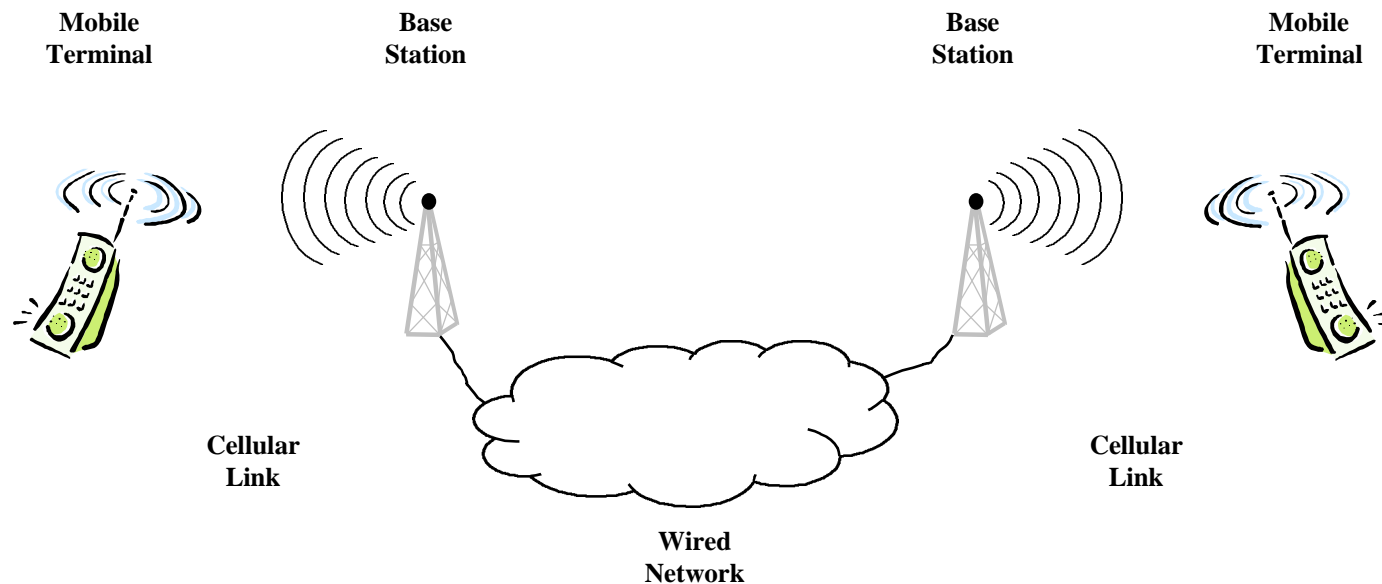**Lars-Erik Jonsson** (Ericsson Research)

Mikael Degermark (Luleå University of Technology)

Hans Hannu (Ericsson Research)

Krister Svanbro (Ericsson Research)

# Introduction

● **Goal: Providing IP to cellular phones and making IP-telephony as speech service economical feasible compared to the traditional circuit switched solution.**



Mobile Terminal    Base Station    Base Station    Mobile Terminal

Cellular Link    Cellular Link

Wired Network

# Characteristics of cellular links

- **High bit-error-rate (BER). A BER of $10^{-3}$ -$10^{-2}$ is not uncommon.**
- **Large round-trip time (RTT). In today's systems, RTTs may be as large as 200 ms.**
- **Expensive bandwidth, meaning that every saved octet per packet is important.**
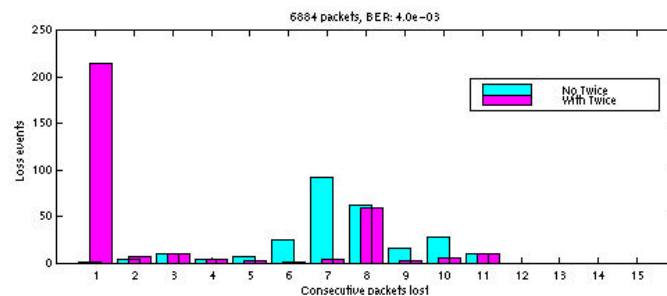
# CRTP evaluation - simulation results:
# CRTP header sizes
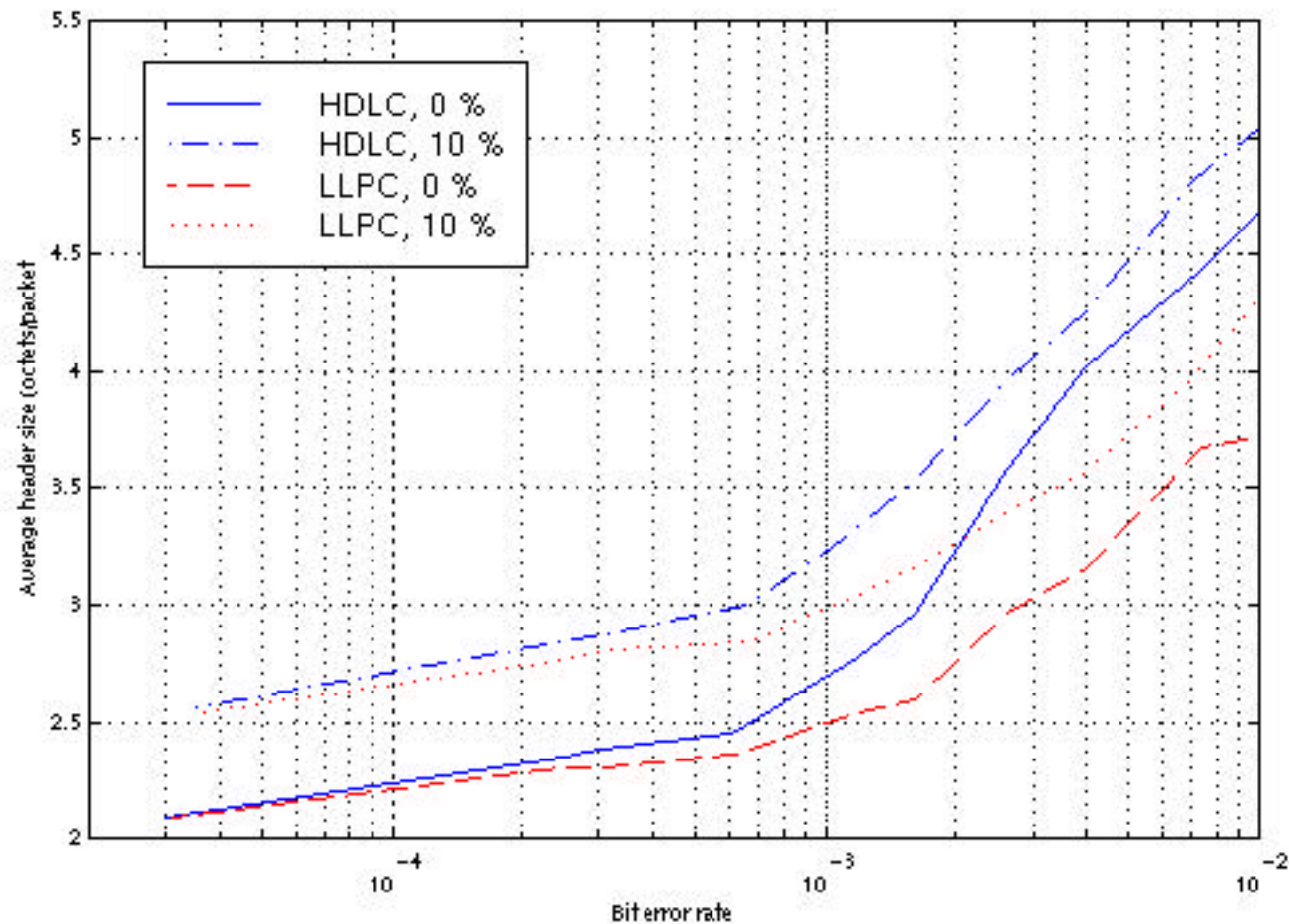
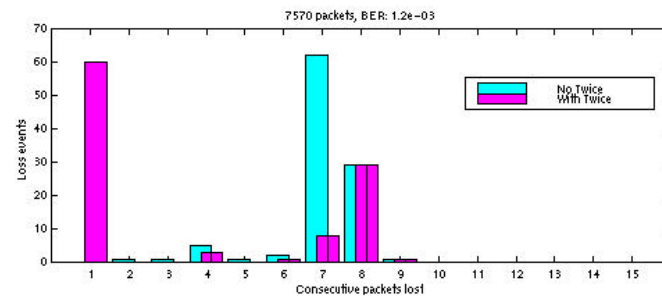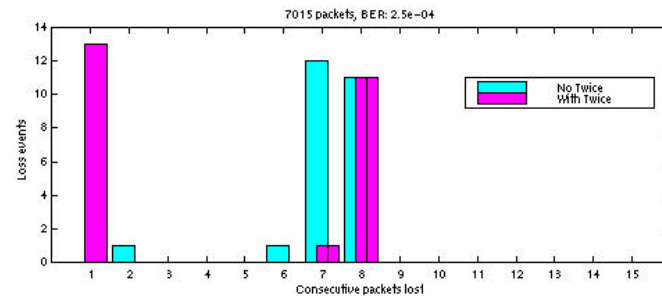# CRTP evaluation - simulation results: Packet loss rates
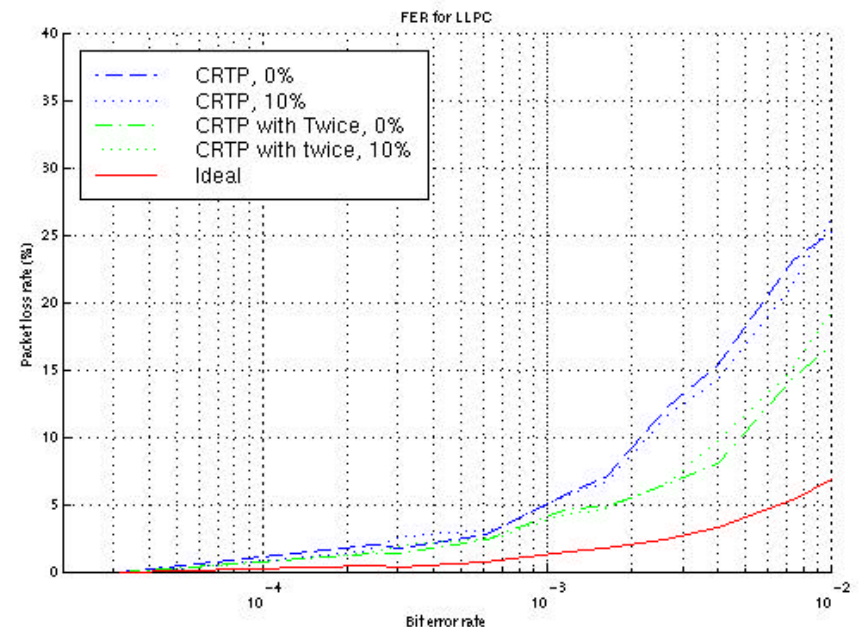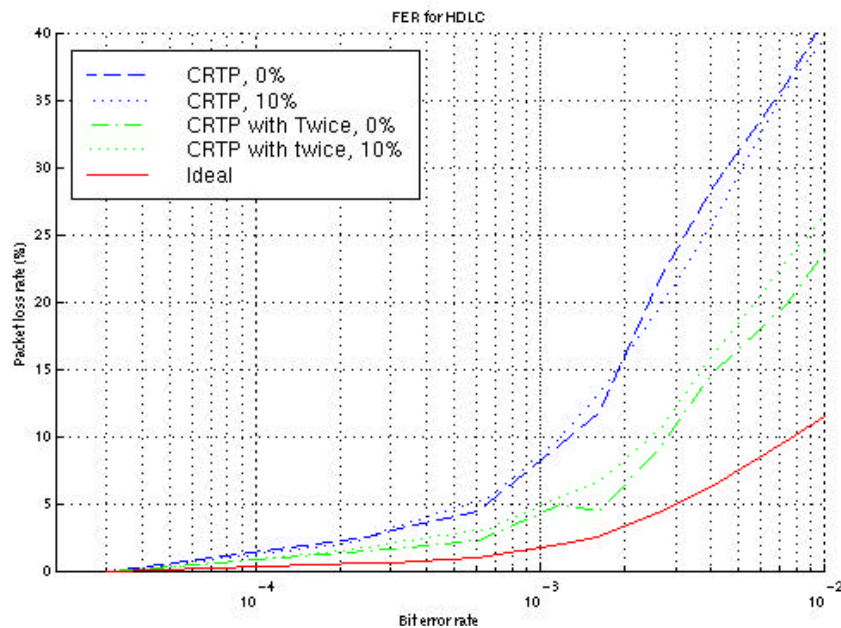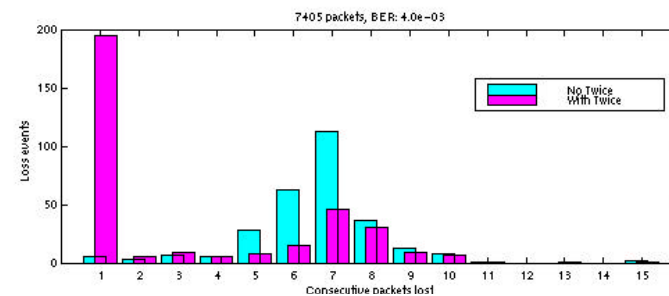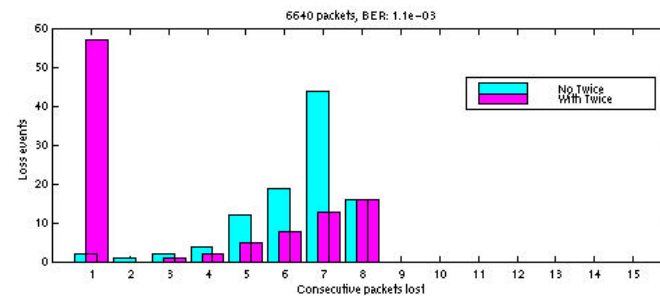
# CRTP evaluation - simulation results:
# Loss distribution



No loss before HC
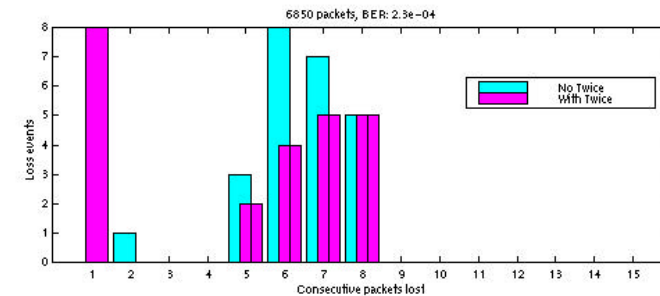
10% loss before HC

## CRTP evaluation - Conclusions:

- CRTP performs very well for BERs less than $10^{-5}$, but not so well for BERs higher than $10^{-4}$.

- The major cause of CRTPs bad performance is that many packets are discarded due to context damage while waiting a link round-trip time for the repair mechanism.

- The losses induced by CRTP is problematic not only because they are high. Also the loss patterns are inappropriate and will certainly cause noticeable voice degradation.

- If only packets with errors in the header part are discarded by the link layer, the loss rate will decrease by 40%.

# Requirements for a new header compression scheme

- **Compressed headers must not be larger than with CRTP, and compression should be optimized as much as possible.**

- **The scheme must be robust against loss before as well as after the compression point.**

- **Implementation and computation simplicity are less important.**

**Summarizing: The scheme must have highest possible COMPRESSION EFFICIENCY while still providing a certain amount of ROBUSTNESS against link errors.**

## RObust Checksum-based header COmpression , ROCCO: Main principles

- **Heavily geared towards local de-compressor context repairs.**
- **Can reliably detect successful repairs through a header compression CRC computed over the header before compression.**
- **A basic framework is specialized for specific kinds of links and packet streams through the use of "profiles".**
  - ◆ **Requires mechanisms for Separation, Identification and Classification of different flows.**

# RObust Checksum-based header COmpression , ROCCO: An IP-telephony profile for cellular links

- **Additional compressed header information is included in a way maximizing the compression efficiency based on the assumed IP-telephony usage of RTP.**

- **Our profile for IP telephony expects steady increments in the RTP sequence number and has a robust encoding of the differences from that behavior in the compressed header.**

- **Compressed header format:**

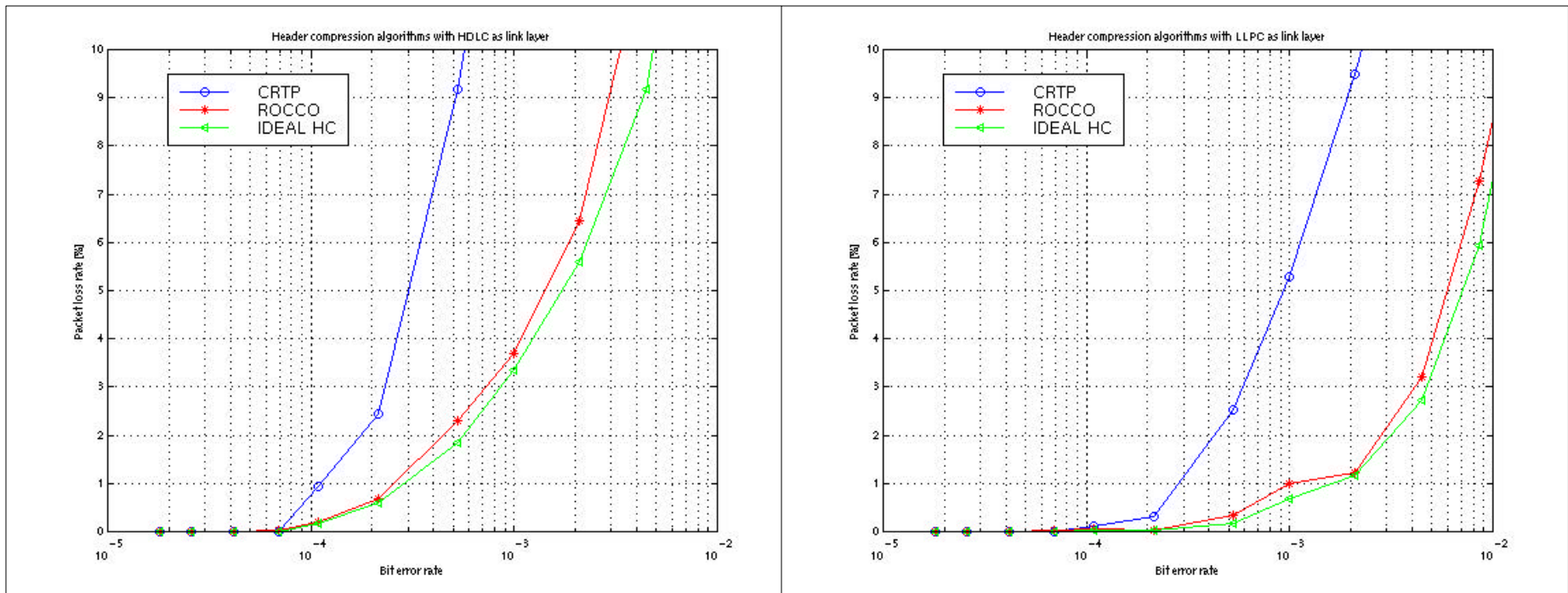| 0 | 9 | 10 | 14 | 15 | | |
|---|---|---|---|---|---|---|
| Header Compresion CRC | | Sequence Code | | X | Extension | Payload |
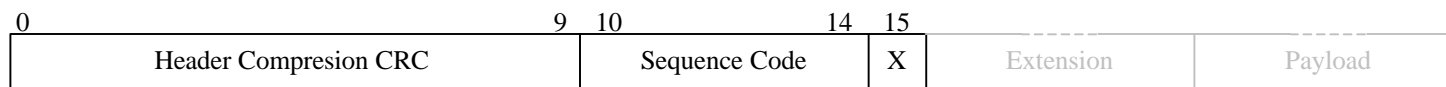
- ◆ **Header Compression CRC is a 10-bit CRC computed over the original packet header.**
- ◆ **The Sequence-Code corresponds to the robust encoding mentioned above.**

# Performance results of ROCCO:
# Header sizes
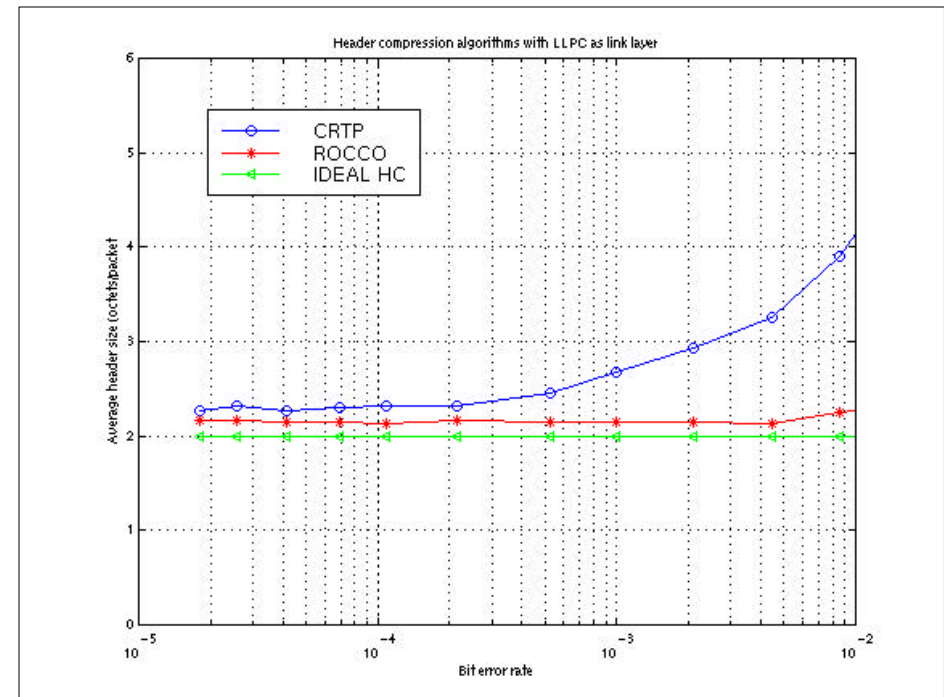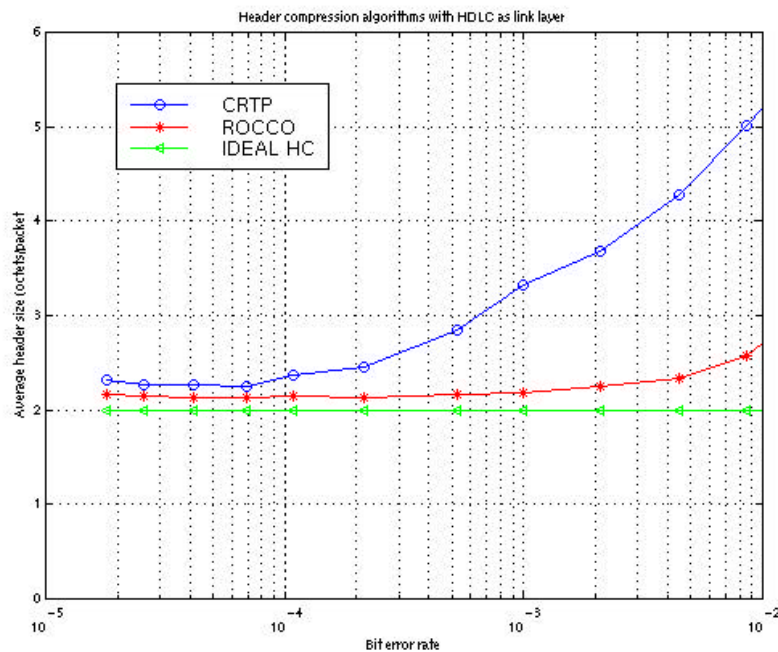
# Performance results of ROCCO:
# Packet loss rate

# Performance results of ROCCO:
# Loss distribution
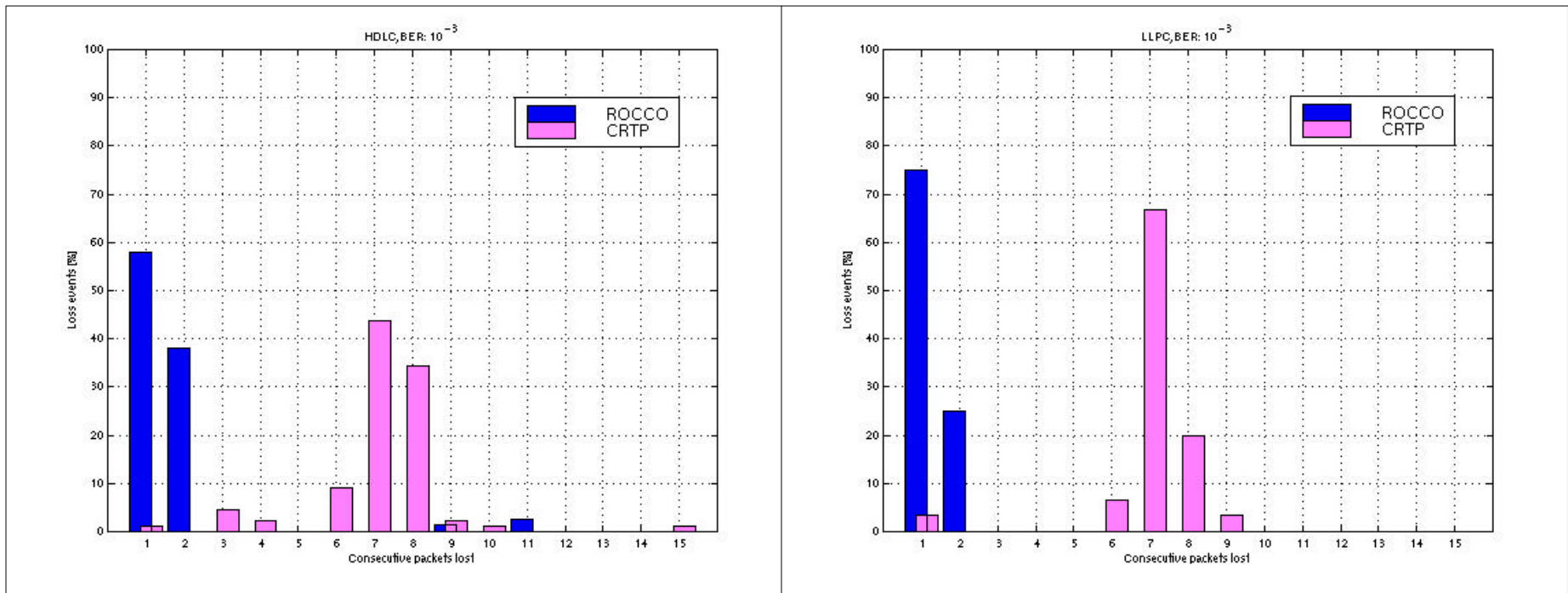
# Conclusions

- **CRTP is an appropriate and general header compression scheme over reliable links and when many different RTP streams are intermixed.**

- **ROCCO-based solutions on the other hand can outperform CRTP and may be needed to make IP telephony economically feasible over cellular links.**

# Documentation and contacts

- **Internet-Drafts**
  - ◆**draft-degermark-crtp-cellular-00.txt/ps**
  - ◆**draft-jonsson-robust-hc-00.txt/ps**

- **Authors**
  - ◆**Lars-Erik Jonsson**     **lars-erik.jonsson@ericsson.com**
  - ◆**Mikael Degermark**     **micke@sm.luth.se**
  - ◆**Hans Hannu**     **hans.hannu@lu.erisoft.se**
  - ◆**Krister Svanbro**     **krister.svanbro@lu.erisoft.se**

# An ideal header compression scheme
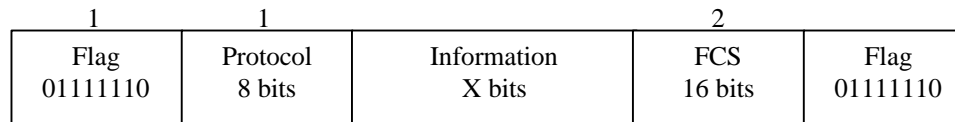
● **Introduced and defined for comparison purposes.**

● **Performs like CRTP would do if used over error-free links to compress input data without irregular changes in its header fields.**

● **Characteristics of the scheme are:**

◆ **The compressed header is always two octets.**

◆ **No packets are lost due to context damage.**

◆ **De-compressor context do not need to be initialized.**
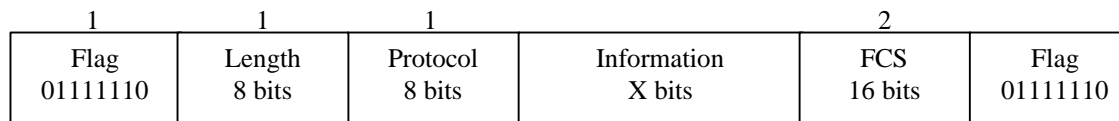
# Used link layers

- **PPP in HDLC-like framing (HDLC)**
  - ◆ **FCS (checksum) covers protocol and the entire information field**
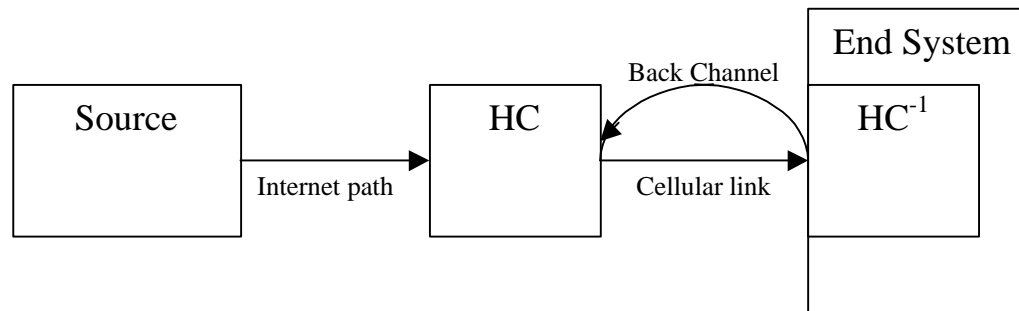  - ◆ **Any errors anywhere in the frame will cause the FCS to fail and the frame will be discarded**

| 1 | 1 | | 2 | |
|---|---|---|---|---|
| Flag 01111110 | Protocol 8 bits | Information X bits | FCS 16 bits | Flag 01111110 |

- **Link layer with partial checksum (LLPC)**
  - ◆ **FCS (checksum) covers an optional part of the Information field, indicated by the length field.**
  - ◆ **Errors in the remaining part of the Information field will not cause the frame to be discarded**

| 1 | 1 | 1 | | 2 | |
|---|---|---|---|---|---|
| Flag 01111110 | Length 8 bits | Protocol 8 bits | Information X bits | FCS 16 bits | Flag 01111110 |

# Simulated scenario



- **Source**
  - ◆ **Generates RTP packets containing speech data.**
- **Speech Source**
  - ◆ **Payload: 16 octets, 20 ms of sound data.**
  - ◆ **Exponentially distributed talk spurts and silence intervals with expected lengths of 1 second.**
- **Cellular Link**
  - ◆ **WCDMA channel.**
- **Back channel**
  - ◆ **Gives an RTT of approximately 120 ms.**
- **Resulting frame-error-rate = Packet loss rate due to link-layer loss and header de-compressor loss.**

# Further work

- **More precisely define the scopes of the header compression framework and the compression profiles.**
- **Improve the IP-telephony profile for cellular links with for instance a more efficient way to handle CSRC lists.**
- **Study how separation and characterization of flows can be done.**
- **Find suitable ways to negotiate the use of compression profiles.**
- **Specify a compression profile for video.**